**Center Innovation Fund: LaRC CIF**

# Doppler Lidar for Measurement of High-Altitude Aircraft Wake Vortices

Completed Technology Project (2012 - 2013)

## Project Introduction

We are developing a Doppler lidar technology for detecting and measuring wake vortices of aircraft. This lidar has been largely developed for meteorological applications, and we are exploring its adaptation to use in this aeronautics application. Wake vortex considerations are important in preventing harmful turbulence encounters in our nation's airspace.

While ground-based Doppler lidar has been used to probe wakes of landing aircraft for many years, these lidars are of a low pulse energy (a few millijoules) that limits their use to short ranges and low altitudes within the atmospheric boundary layer. With NASA's advancement of high pulse energy (250-millijoules) lidar, aircraft wakes could now be measured at long ranges and high altitudes. A ground-based lidar could be used to measure wakes of overflying aircraft to altitudes as high at 20,000 feet. Furthermore, the high-energy lidar could be installed in an aircraft to measure the wakes of other aircraft in flight. The Airspace Systems Program (ASP) is committed to the development of Super Density Operations (SDO) concepts for NextGen. Wake vortices are a fundamental physical limitation that will need to be resolved to enable these SDOs. Understanding wake vortices is a crucial step in the path to NextGen. Under ASP, NASA's wake vortex prediction model development is world-class and is actively involved in both development and validation of these wake models. Access to previously unavailable enroute wake data that would result from this effort represents a huge opportunity to help enable the NextGen goals by providing the ability to conduct robust model validation critical to enabling SDO concepts. To start the development of measuring aircraft wakes from a distant location, we are having an aircraft fly over the lidar in such a way that the aircraft's wakes will drift over the lidar's beam. By placing the target wakes at a known location, we will capture the signal's indicative of a wake vortex. An automated algorithm could then be developed to automatically scan for and lock onto a wake vortex signature. We are also making preliminary designs of adapting the lidar's operation in an aircraft for currently-used meteorological wind measurements to wake vortex measurements. These changes are in the scan pattern of the lidar beam and signal processing.

## Anticipated Benefits

The lidar’s wake measurement capability provides a tool for quantifying wake hazards in NASA’s Airspace Systems Program.

Project Image Doppler Lidar for Measurement of High-Altitude Aircraft Wake Vortices

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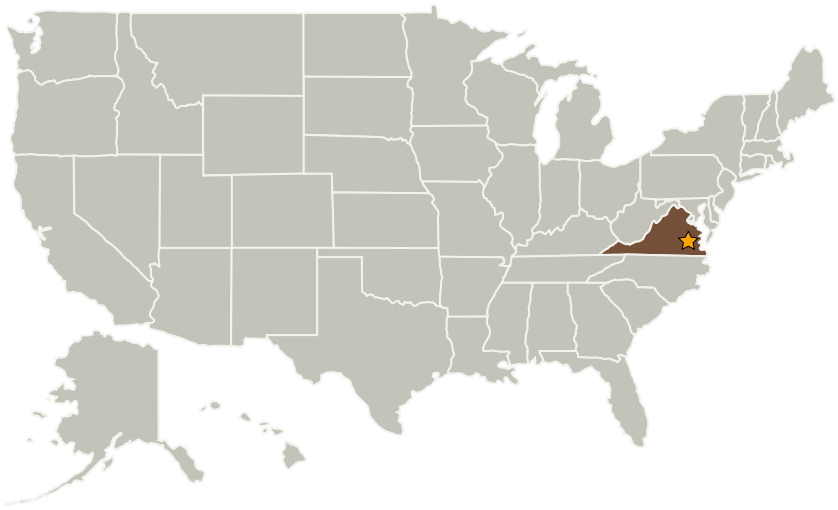
## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| ★Langley Research Center(LaRC) | Lead Organization | NASA Center | Hampton, Virginia |

| Primary U.S. Work Locations |
|---|
| Virginia |

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Langley Research Center (LaRC)

**Responsible Program:**

Center Innovation Fund: LaRC CIF

## Project Management

**Program Director:**

Michael R Lapointe

**Program Manager:**

Julie A Williams-byrd

**Project Manager:**

Jeffrey A Herath

**Principal Investigator:**

Grady J Koch

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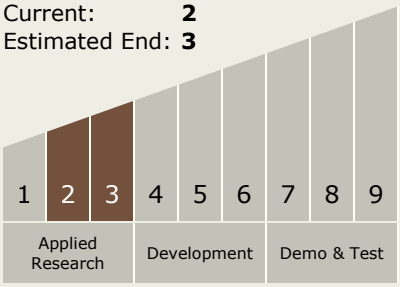
## Images

**37.jpg**
Project Image Doppler Lidar for Measurement of High-Altitude Aircraft Wake Vortices
*(https://techport.nasa.gov/image/1260)*

## Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**




## Technology Areas

**Primary:**

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.5 Lasers